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(54) Counterbalanced orbital drive mechanism for saws and the like

Pendelhubantrieb mit Ausgleichgewicht für Sägen oder dergleichen

Dispositif d'entraînement avec mouvement alternatif et oscillant à contrepoids pour des scies et similaires

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(56) References cited:
DE-A- 3 222 120
US-A- 4 628 605
US-A- 5 079 844

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Description

Background Of The Invention

The present invention relates to a power tool according to the precharacterising portion of claim 1; see US-A-5 079 844. In particular, the present invention relates to such an orbital drive mechanism having a counterbalancing member to minimize vibration.

As is known to those skilled in the art of power tool design, it is desirable to provide reciprocating saws with an orbital movement to facilitate the cutting of materials, such as wood. Power tools of the type under consideration are referred to as recipro saws or jigsaws. As is also known to those skilled in the art, it is desirable to provide these power saws with a counterbalancing mechanism to minimize vibration.

Representative prior art is shown by United States Patents: Bauer 3,890,708; Brookfield 3,945,120; Grossmann, et al. 4,798,001; Martinez, et al. 5,009,012; Palm 5,025,562; and UK patent application 2 181 693.

Summary Of The Invention

The present invention provides a new and improved orbital drive mechanism for a power operated reciprocating saw or the like.

Another object of the present invention is the provision of an orbital drive mechanism for a power operated reciprocal saw or the like which minimizes vibration to the maximum extent by the use of an oscillatory counterweight mechanism.

Still another object of the present invention is the provision of a drive mechanism of the type described which lends itself to compact construction by having the plunger assembly and the counterweight move in planes parallel with the plane of rotation of the drive gear.

These and other objects and advantages of the invention will become apparent from the following specification disclosing a preferred embodiment.

These objects are achieved with a power tool having the features of claim 1.

Description Of The Drawings

FIGURE 1 is a side elevational view of a power tool embodying the present invention with a portion of the tool casing and other parts being broken away for better illustration of the orbital drive mechanism;
FIGURE 2 is a top plan view of the tool shown in Figure 1;
FIGURE 3 is a section taken along the line 3-3 of Figure 2;
FIGURE 4 is an exploded isometric view showing a part of the tool casing and the principal components of the orbital drive mechanism; and
FIGURE 5 is an enlarged exploded isometric view showing the principal parts of the orbital drive mechanism.

Description Of The Invention

Referring to the drawings, a power operated, reciprocating saw, sometimes referred to in the trade as a recipro saw, is generally designated 10. It will be understood that the present invention has applicability to other types of power tools having orbiting reciprocating cutting members, such as a jigsaw.

The power tool includes casing sections 12 and 14. The casing section 12 is preferably made in two parts, including the part 12a as shown in Figure 4. The casing section 14 includes a handle portion 15 mounting an operating trigger 16. The casing section 14 is generally hollow and receives an electric motor, such as a series or universal motor, including a stator 18 and an armature 20. The armature includes an armature or output shaft 22, one end of which is suitably mounted in a bearing assembly 24 supported by the casing 14. The armature shaft 22 includes a commutator 26 engaged by a pair of brushes 28. It will be understood that the drive mechanism of the present invention may be operated by other types of electric motors or even other types of motors, such as a pneumatic motor, for example.

The output shaft 22 has the usual cooling fan 30 mounted thereon. The other or forward end of the output shaft 22 is supported by an annular bearing assembly 32, the latter being suitably mounted in the casing section 12a. A set of beveled pinion teeth 34 is formed on the forward end of the output shaft 22.

Referring now particularly to Figure 4, it will be seen that the bearing 32 is received within annular opening 36 formed in a wall 38, the latter being integral with the housing part 12a. This same housing part includes an integral annular formation 40 which receives a dual ball bearing assembly 42. The dual ball bearing assembly 42 rotatably supports a shaft 44, the latter being suitably mounted in cantilever fashion in the formation 40 by a C-ring 46. The end 44a of the shaft 44 is suitably connected to a gear member, generally designated 48, for supporting the latter for rotation about the axis of the shaft 44.

The gear member 48 includes an annular series of beveled teeth 50; these teeth mesh with the teeth 34 on the end of the motor output shaft 22. Thus, it is apparent that the gear member 48 is driven or rotated by the motor 18.

The gear member 48 has an annular formation 52 suitably secured thereto. It is important to understand that this circular formation is eccentric with respect to the axis of rotation of the gear member 48. Further, the gear member 48 includes a pin 54 which may be characterized as a crank pin as it is eccentric with respect to the axis of rotation of the gear. The pin 54 rotatably supports a roller 56 through a suitable bearing arrangement.

A plunger assembly is generally designated 60. This assembly includes a plunger 62 having a bracket assembly 64 at one end thereof for detachably mounting a saw blade 66 by means of fasteners 68. The other end of the plunger 62 is suitably connected to a block-like member 70 which is connected to a plate 72 by means of fasteners 74. The plate 72 includes a rectilinear slot 76 defining opposed planar sidewalls 76a. It will be seen that the eccentrically mounted roller 56 is received within the slot 76 with diametrically opposed portions of the roller 56 respectively engaging portions of the planar surfaces 76a. The roller 56 and the slot 76 constitute, in essence, a scotch yoke assembly for imparting reciprocal movement to the plunger assembly upon rotation of the gear 48.

It will also be noted that the plate 72 includes opposed planar cam follower surfaces 78 and 80. These planar surfaces are engaged by the annular wall 52 at diametrically oppositely disposed portions on the latter. Since the annular formation 52 is eccentric with respect to the axis of rotation of the gear 48, it is apparent that oscillatory movement will be imparted to the plunger assembly 60 upon rotation of the gear 48 thereby to move the distal end portion of the blade 66 in an orbital path. This movement is orbital in nature because of the dual cam action imparted to the plunger assembly.

Referring particularly to Figures 1 and 2, it will be seen that the plunger 62 is slidably received within an annular bearing member, generally designated 82. The bearing 82 is received within an annular support 84 (Figure 1) which is suitably mounted within the tool casing 12. It will be noted that the bearing 82 has frustoconical formations 86 and 88 which cooperate with the inner surfaces of the bracket 84 to define spaces for receiving O-rings 90 and 92. These O-rings and the clearance spaces between the bearing 82 and the inside surfaces of the bracket 84 cooperate to provide a swivel or swinging mounting for the plunger assembly thereby to permit the oscillatory movement of the latter as referred to above. It will be seen that the bearing 82 cooperates with the planar surfaces 78 and 80 to mount the plunger assembly 60 for oscillating movement in the tool casing.

It should be mentioned in passing that the power tool 10 includes and adjustable foot plate, generally designated 94. This adjustable foot plate forms no part of the present invention and thus requires no further description herein.

Referring now to Figure 5 in particular, the eccentric crank pin 54 is adapted for threading engagement with a fastener 96. The fastener 96 is connected to a disk 98 and serves to mount the latter on the gear 48 for rotation with the latter. The disk 98 defines an annular peripheral formation 100; it is important to understand that this circular formation is eccentric with respect to the axis of rotation of the gear 48. The disk 98 supports an eccentric crank pin 102 which in turn mounts a roller 104 through a suitable bearing assembly. Before describing the primary functions of the disk 98, it should be pointed out that the disk 98 holds the plunger assembly plate 72 into engagement with the annular formation 52 and the roller 56 on the gear 48.

The present invention includes a counterweight member 106 which has a mass substantially the same as the mass of the plunger assembly 60. The counterweight has a planar portion with a slot 108 defining opposed parallel planar formations 108a. It will be understood that the roller 104 is received within the slot 108 with diametrically opposed portions of the former in engagement with corresponding portions of the planar cam follower formations 108a. Thus, the roller 104 and slot 108 constitute, in effect, another scotch yoke mechanism for imparting reciprocal movement to counterweight 106 upon rotation of the gear 48.

The counterweight 106 also includes opposed parallel planar surfaces 110, 112. These planar surfaces engage the annular peripheral formation 100 of the disk 98 at diametrically opposed locations on the latter. Since the disk 98 is eccentric with respect to the axis of rotation of the gear 48, it is apparent that the disk 98 will cooperate with the scotch yoke assembly to impart oscillatory movement to the counterweight 106 upon rotation of the gear 48.

The counterweight 106 includes a further slot 114 which receives a stationary pin 116 mounted on a pedestal formation 118, the latter forming part of the casing part 12a. Thus, the slot 114 cooperates with the planar formations 108a, 110 and 112 for supporting the counterweight 106 for oscillatory movement. The counterweight is further held in place by a washer 120 having a diameter greater than the width of the slot 108. The washer is held in place by a retaining ring 122, the latter being suitably connected to the distal end of the crank pin 102. Thus, the slot 114 and pin 116 cooperate with the planar surfaces 110, 112 to mount the counterweight for oscillating movement in the tool casing. It will be apparent that this movement is essentially orbital in nature in view of the dual cam action imparted to the counterweight.

It will be noted that the crank pins 54 and 102 are in 180 degree relationship with each other. It will also be understood that the radial distance between the axis of rotation of the gear 48 and the axis of the pin 54 is the same as the distance between the axis of rotation of the gear 48 and the axis of the pin 102. Thus, when the scotch yoke constituted by the roller 56 and slot 76 serves to move the plunger assembly 60 in one direction the other scotch yoke constituted by the roller 104 and slot 108 will move the counterweight 106 in an opposite direction. Similarly, the eccentric axes of the annular formation 52 and the annular formation 100 are in 180 degree relationship with each other. Further, the distance between the axis of rotation of the gear member 48 and the central axis of the formation 52 is the same as the distance between the axis of rotation of the gear 48 and the central axis of the annular formation

100. Accordingly, when the annular formation 52 serves to move the plunger assembly 60 in one direction, the annular formation 100 serves to move the counterweight in the opposite direction. It will also be understood that the various parts are designed so that the distance between the center of mass of the plunger assembly 60 and the center of mass of the counterweight 106 are at a minimum. Hence, in accordance with the present invention, vibration is reduced to a maximum extent.

It will also be appreciated that the present invention lends itself to very compact construction which is of great importance in the design of a portable power tool. This is achieved by having all principal parts of the drive mechanism sandwiched in close relationship and mounted for movement in planes parallel with the plane of rotation of the gear 48.

While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but, on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be included within the scope of the claims.

Claims

1. A power tool for imparting orbital movement to a saw blade comprising:

   (a) a casing (12, 14);
   (b) a motor (18, 20) mounted within said casing including a rotary output member (22);
   (c) a plunger assembly (62) swingably supported by said casing for mounting a saw blade (66); and
   (d) a drive mechanism contained within said casing and connected to said motor and said plunger assembly for imparting oscillatory movement to the latter and including:

      (1) a gear (48) driven by said rotary output member;
      (2) first compound cam means including first (56) and second (52) cam elements mounted on said gear;
      (3) said plunger assembly including first (76) and second cam (78, 80) following surfaces in respective engagement with said first and second cam elements such that rotation of such gear imparts orbital movement to at least a portion of said plunger assembly;
      (4) second compound cam means (98) mounted on said gear;
      (5) a counterweight (106) having a mass substantially the same as the mass of the plunger assembly and mounted for movement independently of the plunger assembly; **characterized in that**
      (6) said counterweight including cam following means (110, 112) in engagement with said second compound cam means (98) whereby at least a portion of said counterweight is actuated to move in an orbital path upon rotation of said gear.

2. The power tool according to claim 1 further defined by:

   (a) said second compound cam means (98) including third and fourth cam elements mounted on said gear; **characterized in that**
   (b) said counterweight (106) including third and fourth cam following surfaces in engagement with said third and fourth cam elements, respectively, such that orbital movement is imparted to at least a portion of said counterweight to counterbalance movement of the plunger assembly (60).

3. The power tool according to claim 1 further defined by:

   (a) said gear (48) being mounted for rotation in a first plane; and
   (b) said plunger and said counterweight being mounted for movement in respective second and third planes each parallel with said first plane.

4. The power tool according to claim 3, **characterized in that** said gear (48) is a beveled gear contained in a plane parallel with the axis of rotation of said rotary output member (34).

5. The power tool according to claim 1 further defined by:

   (a) first and second different annular cam formations (52, 56) mounted on said gear and each being eccentric with respect to the axis of rotation of the gear;
   (b) first and second sets of opposed cam follower formations (78, 80) forming part of said plunger assembly with the first set of cam follower formations being engaged by said first annular cam formation (52) at diametrically opposed locations on the latter and with the second set of cam follower formations (76) being engaged by said second annular cam formation (56) at diametrically opposed locations on the latter,
   characterized by
   (c) third (100) and fourth (104) different annular cam formations mounted on said gear (54) and each being eccentric with respect to the axis of

rotation of the gear;

(d) third (110, 112) and fourth (108) sets of opposed cam follower formations formed on said counterweight member with the third set of cam follower formations (100) being engaged by said third annular cam formation (100) at diametrically opposite locations on the latter and with the fourth set of cam follower formations (108) being engaged by said fourth annular cam formation (104) at diametrically opposed locations on the latter;

(e) first mounting means (72) including at least said first cam follower formation mounting said plunger assembly for orbital movement in a plane parallel with the plane of rotation of said gear; and

(f) second mounting means including at least said third cam follower formation mounting said counterweight (106) for orbital movement in a plane parallel with the plane of rotation of said gear.

6. The power tool according to claim 5, **characterized in that** said second and fourth cam formations and the respective second and fourth cam follower formations constitute separate scotch yoke assemblies.

7. The power tool according to claim 6, **characterized in that** said first (78, 80) and third (110, 112) cam follower formations are in parallel relationship with each other and wherein said second (76) and fourth (108) cam follower formations are in parallel relationship with each other and in 90 degree relationship with the first and third cam follower formations.

8. The power tool according to claim 5, **characterized in that** the axis of rotation of the rotary output member (34) is parallel with the plane of rotation of said gear (48).

Patentansprüche

1. Angetriebenes Werkzeug zum Erzeugen einer Umlaufbewegung für ein Sägeblatt, mit:

(a) einem Gehäuse (12, 14);

(b) einem Motor (18, 20), der innerhalb des Gehäuses montiert ist, mit einem rotierenden Abtriebsteil (22);

(c) einer Plungeranordnung (62), die an dem Gehäuse zum Montieren des Sägeblattes (66) schwenkbar abgestützt ist; und

(d) einem Antriebsmechanismus, der innerhalb des Gehäuses untergebracht ist und mit dem Motor und der Plungeranordnung zum Erzeugen einer oszillierenden Bewegung der letzteren verbunden ist, und der aufweist:

(1) ein Getriebe (48), das von dem rotierenden Abtriebsteil angetrieben wird;

(2) erste zusammengesetzte Nockenmittel, die erste (56) und zweite (52) Nockenteile aufweist, die an dem Getriebe montiert sind;

(3) wobei die Plungeranordnung erste (76) und zweite (78, 80) Nockenmitnehmerflächen aufweist, die mit den ersten bzw. den zweiten Nockenteilen derart in Eingriff stehen, daß die Drehbewegung des Getriebes eine Umlaufbewegung zumindest eines Abschnitts der Plungeranordnung erzeugt;

(4) zweite zusammengesetzte Nockenmittel (98), die an dem Getriebe montiert sind;

(5) ein Gegengewicht (106), das eine Masse aufweist, die im wesentlichen gleich der Masse der Plungeranordnung ist, und das für die Bewegung unabhängig von der Plungeranordnung montiert ist; **dadurch gekennzeichnet, daß**

(6) das Gegengewicht Nockenmitnehmermittel (110, 112) aufweist, die mit den zweiten zusammengesetzten Nockenmitteln (98) in Eingriff stehen, wobei zumindest ein Abschnitt des Gegengewichts betätigt wird, um sich in einer Umlaufbahn aus der Drehbewegung des Getriebes zu bewegen.

2. Angetriebenes Werkzeug nach Anspruch 1, wobei:

(a) die zweiten zusammengesetzten Nockenmittel (98) dritte und vierte Nockenteile aufweisen, die an dem Getriebe montiert sind; **dadurch gekennzeichnet, daß**

(b) das Gegengewicht (106) dritte und vierte Nockenmitnehmerflächen aufweist, die mit den dritten bzw. vierten Nockenteilen derart in Eingriff stehen, daß eine Umlaufbewegung zumindest eines Abschnitts des Gegengewichts aus der Gegengewichtsbewegung der Plungeranordnung (609 erzeugt wird.

3. Angetriebenes Werkzeug nach Anspruch 1, wobei:

(a) das Getriebe (48) für eine Drehbewegung in einer ersten Ebene montiert ist; und

(b) der Plunger und das Gegengewicht für eine Bewegung in zweiten bzw. dritten Ebenen jeweils parallel zu der ersten Ebene montiert sind.

4. Angetriebenes Werkzeug nach Anspruch 3, **dadurch gekennzeichnet, daß** das Getriebe (48) ein schrägverzahntes Getriebe ist, das in einer Ebene parallel zur Drehachse des rotierenden

Abtriebsteils (34) untergebracht ist.

5. Angetriebenes Werkzeug nach Anspruch 1, mit:

(a) ersten und zweiten unterschiedlichen ringförmigen Nockengebilden (52, 56), die an dem Getriebe montiert sind und jeweils relativ zur Drehachse des Getriebes exzentrisch sind;
(b) ersten und zweiten Sätzen von einander gegenüberliegenden Nockenmitnehmergebilden (78, 80), die einen Teil der Plungeranordnung bilden, wobei der erste Satz der Nockenmitnehmergebilde mit dem ersten ringförmigen Nockengebilde (52) an diametral einander gegenüberliegenden Stellen des letzteren in Eingriff steht, und wobei der zweite Satz der Nockenmitnehmergebilde (76) mit dem zweiten ringförmigen Nockengebilde (56) an diametral einander gegenüberliegenden Stellen des letzteren in Eingriff steht,
gekennzeichnet durch
(c) dritte (100) und vierte (104) unterschiedliche ringförmige Nockengebilde, die an dem Getriebe (54) montiert sind und jeweils relativ zur Drehachse des Getriebes exzentrisch sind;
(d) dritte (110, 112) und vierte (108) Sätze von einander gegenüberliegenden Nockenmitnehmergebilden, die an dem Gegengewichtsteil ausgebildet sind, wobei der dritte Satz der Nokkenmitnehmergebilde (110, 112) mit dem dritten ringförmigen Nockengebilde (100) an diametral einander gegenüberliegenden Stellen des letzteren in Eingriff steht, und wobei der vierte Satz der Nockenmitnehmergebilde (108) mit dem vierten ringförmigen Nockengebilde (104) an diametral einander gegenüberliegenden Stellen des letzteren in Eingriff steht;
(e) erste Montagemittel (72), die zumindest das erste Nockenmitnehmergebilde aufweisen, das die Plungeranordnung für die Umlaufbewegung in einer Ebene parallel zu der Ebene der Drehbewegung des Getriebes trägt; und
(f) zweite Montagemittel, die zumindest das dritte Nockenmitnehmergebilde aufweisen, das das Gegengewicht (106) für die Umlaufbewegung in einer Ebene parallel zur Ebene der Drehbewegung des Getriebes trägt.

6. Angetriebenes Werkzeug nach Anspruch 5, **dadurch gekennzeichnet, daß** die zweiten und die vierten Nockengebilde und die jeweiligen zweiten und vierten Nockenmitnehmergebilde separate Kulissenanordnungen bilden.

7. Angetriebenes Werkzeug nach Anspruch 6, **dadurch gekennzeichnet, daß** die ersten (78, 80) und die dritten (110, 112) Nockenmitnehmergebilde in paralleler Beziehung zueinander stehen, wobei die zweiten (76) und die vierten (108) Nockenmitnehmergebilde in paralleler Beziehung zueinander und in einer Beziehung von 90 Grad zu den ersten und den zweiten Nockenmitnehmergebilden stehen.

8. Angetriebenes Werkzeug nach Anspruch 5, **dadurch gekennzeichnet, daß** die Drehachse des rotierenden Abtriebsteils (34) parallel zu der Ebene der Drehbewegung des Getriebes (48) ist.

Revendications

1. Outil à moteur destiné à imprimer un mouvement orbital à une lame de scie, comprenant :

(a) un carter (12, 14) ;
(b) un moteur (18, 20) monté dans ledit carter et comprenant un élément de sortie rotatif (22) ;
(c) un ensemble plongeur (62) supporté mobile en oscillation par ledit carter pour porter une lame de scie (66) ; et
(d) un mécanisme d'entraînement contenu dans ledit carter et relié audit moteur et audit ensemble plongeur pour imprimer un mouvement oscillant à ce dernier, et comprenant :

(1) un engrenage (48) entrainé par ledit élément de sortie rotatif ;
(2) des premiers moyens à came composés comprenant des premier (56) et deuxième (52) éléments de came montés sur ledit engrenage ;
(3) ledit ensemble plongeur comprenant des première (76) et deuxièmes (78, 80) surfaces de contre-came qui coopèrent respectivement avec lesdits premier et deuxième éléments de came de telle manière que la rotation dudit engrenage imprime un mouvement orbital à au moins une portion dudit ensemble plongeur ;
(4) des deuxièmes moyens à came composés (98) montés sur ledit engrenage ;
(5) un contrepoids (106) ayant une masse à peu près égale à la masse de l'ensemble plongeur, et monté pour entrer en mouvement indépendamment de l'ensemble plongeur ;
caractérisé en ce que
(6) ledit contrepoids comprend des moyens de contre-came (110, 112) qui coopèrent avec lesdits deuxièmes moyens à came composés (98), de sorte qu'au moins une portion dudit contrepoids est actionnée pour se déplacer en un trajet orbital en réponse à la rotation dudit engrenage.

2. Outil à moteur selon la revendication 1, défini en outre par le fait que :

(a) lesdits deuxièmes moyens à came composés (98) comprennent des troisième et quatrième éléments de came montés sur ledit engrenage ; caractérisé en ce que
(b) ledit contrepoids (106) comprend des troisième et quatrième surfaces de contre-came coopérant respectivement avec lesdits troisième et quatrième éléments de came, de sorte qu'un mouvement orbital est imprimé à au moins une portion dudit contrepoids pour contre-balancer le mouvement de l'ensemble plongeur (60).

3. Outil à moteur selon la revendication 1, défini en outre par le fait que :

(a) ledit engrenage (48) est monté pour tourner dans un premier plan ; et
(b) ledit plongeur et ledit contrepoids sont montés pour se déplacer respectivement dans des deuxième et troisième plans dont chacun est parallèle audit premier plan.

4. Outil à moteur selon la revendication 3, caractérisé en ce que ledit engrenage (48) est un engrenage conique contenu dans un plan parallèle à l'axe de rotation dudit élément de sortie rotatif (34).

5. Outil à moteur selon la revendication 1, défini en outre par :

(a) des première et deuxième formations de came annulaires différentes (52, 56) montée sur ledit engrenage et dont chacune est excentrique par rapport à l'axe de rotation de l'engrenage ;
(b) des premier et deuxième jeux de formations de contre-came (78, 80) qui font partie dudit ensemble plongeur, ledit premier jeu de formations de contre-came étant attaqué par ladite premières formation de came annulaire (52) dans des emplacements diamétralement opposés de cette dernière, et le deuxième jeu de formations de contre-came (76) étant attaqué par ladite deuxième formation de came annulaire (56) dans des emplacements diamétralement opposés de cette dernière,
caractérisé par
(c) des troisième (100) et quatrième (104) formations de came annulaires différentes montées sur ledit engrenage (54) et dont chacune est excentrique par rapport à l'axe de rotation de l'engrenage ;
(d) des troisième (110, 112) et quatrième (108) jeux de formations de contre-came opposées formés sur ledit élément de contrepoids, le troisième jeu de formations de contre-came (100) étant attaqué par ladite troisième formation de came annulaire (100) dans des emplacements diamétralement opposées de cette dernière, et le quatrième jeu de formations de contre-came (108) étant attaqué par ladite quatrième formation de came annulaire (104) dans des emplacements diamétralement opposés de cette dernière ;
(e) des premiers moyens de montage (72) comprenant au moins ladite première formation de contre-came qui porte ledit ensemble plongeur pour lui permettre de décrire un mouvement orbital dans un plan parallèle au plan de rotation dudit engrenage ; et
(f) des deuxièmes moyens de montage comprenant au moins ladite troisième formation de contre-came qui porte ledit contrepoids (106) pour lui faire décrire un mouvement orbital dans un plan parallèle au plan de rotation dudit engrenage.

6. Outil à moteur selon la revendication 6, caractérisé en ce que lesdites deuxième et quatrième formations de came et les deuxième et quatrième formations de contre-came respectives constituent des ensembles à coulisse séparés.

7. Outil à moteur selon la revendication 6, caractérisé en ce que lesdites première (78, 80) et troisième (110, 112) formations de contre-came sont dans des positions relatives parallèles entre elles, et dans lequel lesdites deuxième (76) et quatrième (108) formations de contre-came sont dans des positions relatives parallèles entre elles et dans des positions relatives tournées de 90° par rapport au première et troisième formations de contre-came.

8. Outil à moteur selon la revendications 5, caractérisé en ce que l'axe de rotation de l'élément de sortie rotatif (34) est parallèle au plan de rotation dudit engrenage (48).

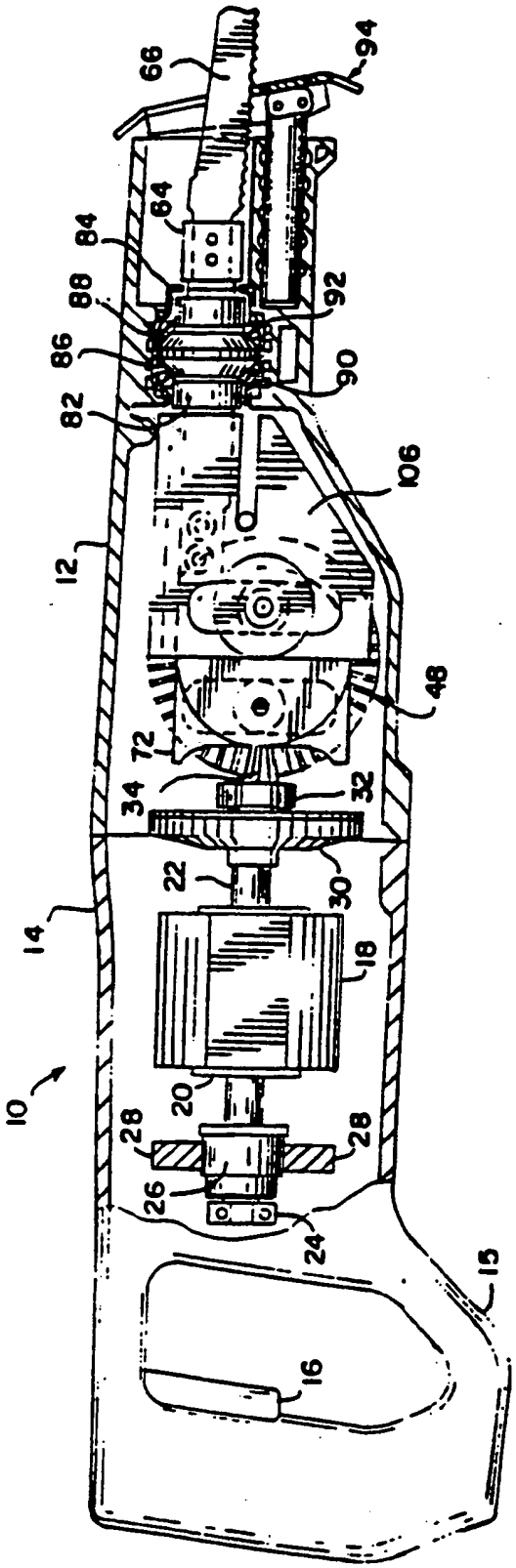

FIG. 1

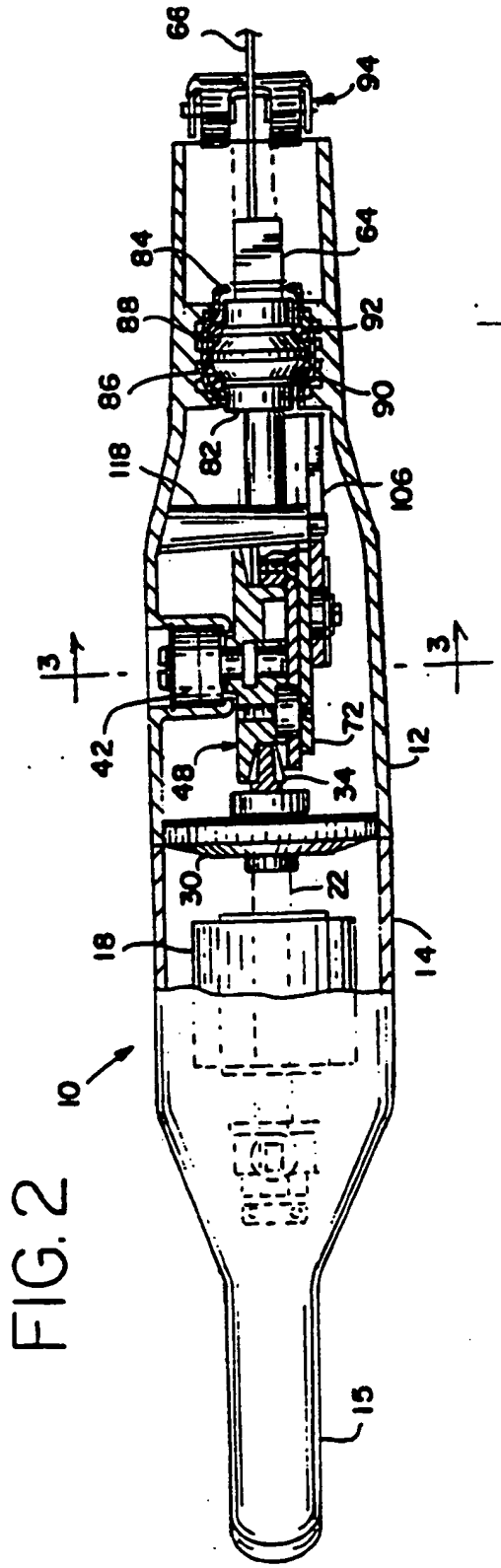

FIG. 2

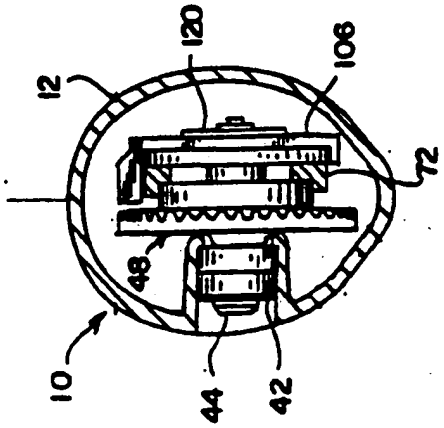

FIG. 3

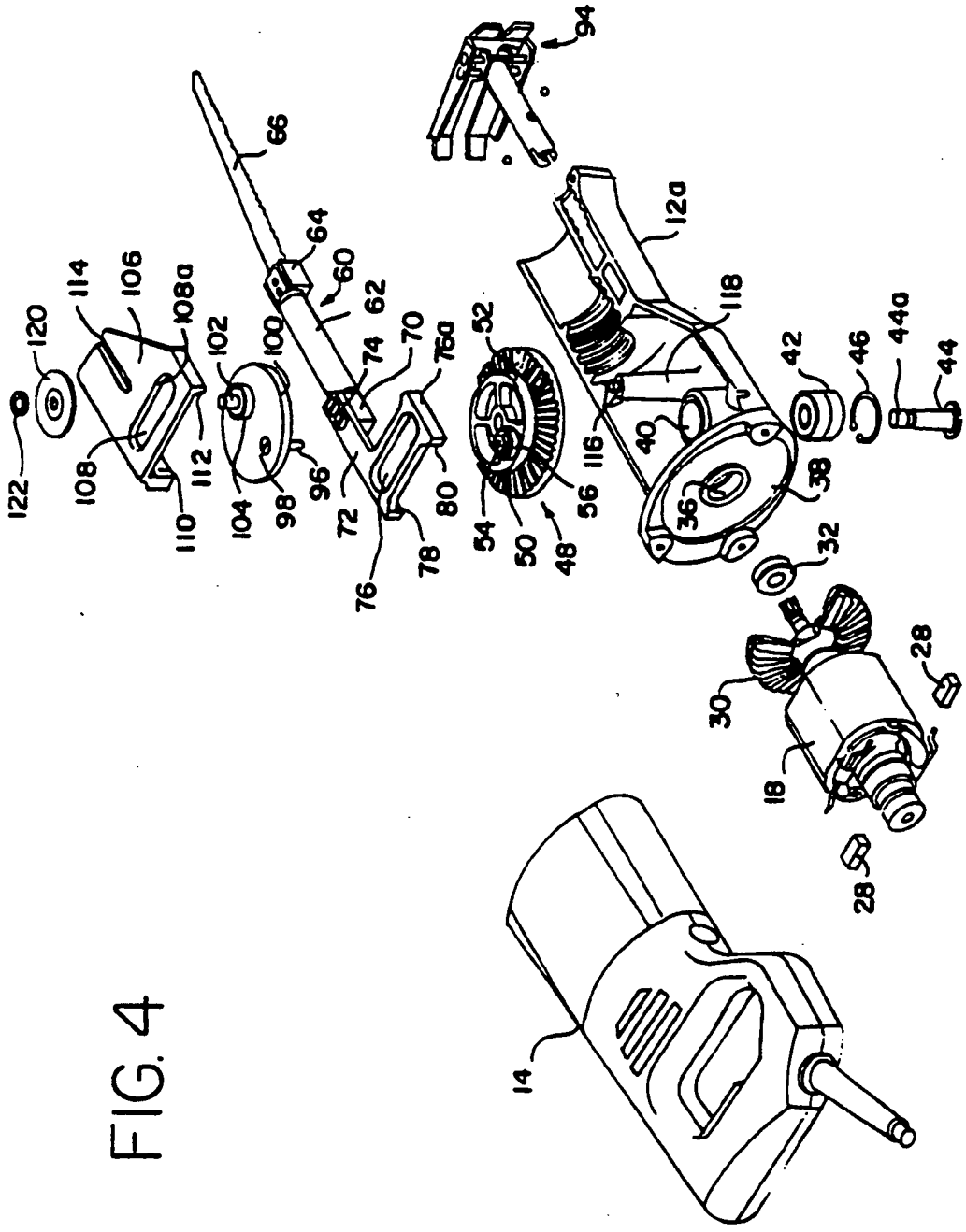

FIG. 4

FIG.5